#### Memo from DTS is in black

#### MxV Rail (TTCI) responses are in blue.

Flange-Bearing Frog Long Term Solution

Date: June 9, 2022

Background:

The Honolulu Rail Transit Project (HRTP) turnout and diamond frogs located on the mainline tracks have two unique characteristics that are extremely rare for mainline track frogs. These frogs are both flangebearing frogs (FBF) and they are also self-guarded frogs. Furthermore, the HRTP is mostly all FBFs, while most rail systems whom possess FBF typically only have a small portion of their network consist of FBFs.

NOTE: Six (6) of the track SMEs employed by either DTS, HRH or Stantec, each were surprised to see these types of frogs on the mainline tracks and stated that these FBFs are designed and only allowed to be used in yards, not mainline tracks upon their initial viewing of the mainline track frogs.

- 1. Steven Bose, Senior Operations & Maintenance Manager (SOMM) DTS
- 2. Yifeng Mao, Track Compliance Officer (TCO)- DTS
- 3. Jeremy Crutchfield, Maintenance of Way (MOW) Manager HRH
- 4. Leroy Henry, MOW Manager HRH
- 5. Bernard Glover, Track Inspector HRH
- 6. Dave Walker, Track & Systems Manager Stantec

MxV Rail (TTCI) responses: The designer and the manufacturer designed and manufactured these frogs for HART mainline operating speeds. MxV Rail (TTCI) was tasked with conducting modeling simulations to determine safe operating speeds.

Furthermore, in 2020 and 2021, DTS took photos of concerning evidence to demonstrate a wheel/rail interface concern. First on September 9, 2020 when our TCO noticed a concerning potential wheel strike mark at the LCC DXO. Then on February 19, 2021 HRH reported the first of two of the FBFs had cracks in the bottom of the flange-way at PLR3A, the second cracked FBF was reported on February 23, 2021 and based on wear/wheel strike marks which were photographed by DTS, we believe these cracks were caused by wheel hop due to an improper wheel/rail interface at the frogs on the mainline tracks when the passenger vehicles traveled over the Maximum Authorized Speed (MAS) as identified by both the FRA and APTA for FBFs (MAS 15 MPH).

MxV Rail (TTCI) responses: (1) For the crack observed at EKA3A, TTCI commented that it was a manufacturing defect rather than a result of the wheel flange running on the flangeway (see TTCI Phase I report). (2) The FRA limits class 1 track to 15 mph. The FRA has no such restriction on flange bearing/ tread bearing frogs.

HART and DTS agreed to bring in TTCI in mid-2021 to confirm there was not an incompatibility issue with the FBFs per Jacob's proposed guarding plan and the HRH Wheels. TTCI was tasked to perform a Phase 1

and Phase 2 study. A little after the TTCI Phase 1 Final Report was completed in early 2022, we were notified that there was a newly discovered tight gage issue at each of the DXOs.

## MxV Rail (TTCI) responses: TTCI discovered the tight gage issue while preparing the phase 2 simulations. Phase 1 used mainly design track geometry, while Phase 2 used actual track geometry.

In the TTCI Phase 1 report TTCI stated it was safe to operate at higher speeds if HART replaced the current wheel to a wider wheel, made some modifications to the guarding/welding plan, and reduce the track maintenance tolerances to a stricter construction installation typical tolerance. DTS requested more information from TTCI and questioned why TTCI chose to focus on FRA standards while ignoring FTA recommendations. DTS comments on the Phase 1 report were simply disregarded and DTS just provided our comments on the TTCI Phase 2 study on April 14, 2022. TTCI and HART failed to use TCRP 155 ramp rating recommended speeds.

MxV Rail (TTCI) responses: (1) These descriptions are not correct. TTCI stated it was safe to operate mainlines as is. (2) DTS was aware of the simulation plan, having had input into the scope of work and reviews of the project progress every two weeks. CFR 213.333 was chosen and agreed to by all parties involved prior to start of work. The FRA criteria are more comprehensive than any other guidelines. FTA does not have the safety criteria applicable to this study. TCRP 155 is not an FTA publication and does not include safety criteria comparable to those in CFR 213.333. (3) Also, DTS comments were considered during the study and for the final phase I report. TTCI did not use all DTS suggestions nor make all DTS report edits.

DTS TCO asked HART/TTCI at least 3-times, twice he asked in writing by e-mail in responding to the track parametric study values, and another time, our TCO asked during the TTCI call on Dec. 21, 2021, but it remained unanswered. Our TCO, RSCO and I concur with the TCRP 155 Sect. 6.6.3.2 Flange-way Ramping, however the TTCI's Final Report in Phase 1, disregarded it (See below in bold lettering), and however, we provided the exceptions to this in our review response sent back to HART/TTCI, in Comment #16, and #32. Please see DTS question 16 below and note DTS response in bold red letters immediately following HARTs response in black bold letters.

MxV Rail (TTCI) responses: (1) The concern raised by DTS was addressed each time. As responded above, TCRP 155 is not an FTA publication and does not include safety criteria comparable to CFR 213.333, rather it includes information as design recommendations. TTCI was tasked with determining if the HART vehicles could operate over the already built frogs at 55 mph mainline and 20 mph diverging speeds. TTCI ran NUCARS simulations to determine whether the intended operations met the best available safety criteria (i.e. CFR 213.333), which was agreed by all stakeholders. (2) TTCI was not asked to design the frogs nor recommend an optimal ramp rate.

Question #16: 1. Explain how was the design in the FBF ramps as per TCRP Report 155, paragraph 6.6.3.2 Flangeway Ramping are addressed to ensure the recommended practice and guidelines are followed, or was this simply ignored? 2. If so what was the justification in dismiss the TCRP 155 guidance to the FBF ramps in the design for authorizing the maximum speed for both tangent moves and divergent moves? - See Ref. "... Comparison of simulations with and without re-created track geometry showed that track geometry deviations seen in the data were as important in generating vehicle response as the FBF ramps."

"TTCI made a reference to TCRP Report 155 under "1.0 Introduction". TTCI made a statement that the report "does not provide scientific data either from testing or modeling to support some of the guidelines provided". The whole purpose of this study was to determine if the vehicles can be operated at the recommended speeds without safety issues (as determined by CFR 213.333 criteria). The simulations show that no safety limits are exceeded. Also, we have considerable experience with less capable vehicles (freight cars and passenger cars with simpler suspensions) and flange bearing ramps that are much steeper than those recommended by TCRP 155. See, for example, TD11-018 Implementation Guidelines for Flange Bearing Frogs. The AAR uses a fatigue criterion that is more conservative than CFR 213.333."

"DTS disagrees; As the Honolulu rail transit system is under FTA regulation, not FRA or AAR, it is extremely imperative that the only the FTA regulations and guidelines for FTA must be used, which FTA's TCRP Report 155 is FTA's Transit Design Handbook for the transit industry, and must comply. Please ensure FTA, not FRA criteria, is to be used. This study needs to follow FTA guidelines, please ensure 6.6.3.2 Flangeway Ramping in FTA's TCRP 155 is followed. Per HART (CEO)/DTS (DRT), please ensure FTA, not FRA criteria, is to be used."

MxV Rail (TTCI) responses: (1) MxV Rail has responded above about our approach in not using that specific statement from TCRP 155. TCRP 155 gives a design recommendation. TTCI was tasked with determining if the already built DXOs can be operated safely. We were not asked to design frogs. (2) Again, all parties agreed to the simulation plan that using CFR 213.333 was the best way to evaluate the safety of the proposed operations.

As mentioned on page 1, we became aware of the tight gage issues at all of the DXOs in early 2022. DTS has recently learned of new ride quality concerns since those adjustments were made. A video surfaced and there is concerns of a major lateral jerk when crossing over the Pearlridge DXO. Since lifting the speed restriction HART has on two occasions' suspended operations using the DXOs, due to an inspection measurement suspect concern in April and more recently a tight flange-way width in May.

Additionally, on May 6, 2022 DTS Rolling Stock Compliance Officer, Ben Holland reported: "Today, Mr. Nieves and myself rode train 10 over the entire Segment 1, both tracks T1 and T2, from end to end. We had the same following observations regardless of direction or location. Slow speed curving seemed good relative to the rest of the operation. However, all train movement on tangent track had noticeable and at times uncomfortable side-to-side train movement. There is easily observable track wear to confirm this uncomfortable train motion as can be seen in the attached pictures. Also evident in the pictures is clear 2-point contact wherever this side-to-side motion is observed.

I don't recall our previous train ride on train 12 being this bad. I also don't think this is a safety concern, however, in my mind this is definitely a concern for track maintenance and for wheel maintenance. In my experience, 2-point contact is typically a catalyst for rail corrugation. It seems that as the system is wearing in with the newly cut 1:20 wheel profile, it is not wearing in a stable way, and the side-to-side motion and resultant rail wear is getting worse, not better."

MxV Rail (TTCI) responses: (1) The tight gage issue is entirely separate from the frog design and is not a result of FBF design. (2) The tight gage in diverging DXO tracks is only present in the frog areas. It is highly unlikely that ~50-100 feet of tight gage on the rare cross-over diverging moves can cause the worn wheel profiles of HART vehicles running many miles of conventional track per day.

#### Summary:

An outcome of the TTCI work was a new requirement for tighter construction installation type maintenance tolerances. These maintenance tolerances are too restrictive and unmaintainable, as seen in my notes documenting HRH's comments with both DTS and HART at a meeting held on January 26, 2022. HRH cannot even use standard track inspection tools. The wheels, frogs and track measurement tools are no longer off the shelf. The ride quality appears to have been compromised from the tight gage adjustments, which will affect our overall customer satisfaction goals.

MxV Rail (TTCI) responses: DTS conflates frog design and frog guarding and concludes that FBFs require tighter maintenance tolerances. This is not true, as has been discussed many times at project meetings. The guarding requirements are the same for any fixed-point frogs, FBFs or tread bearing frogs.

RECOMMENDATION: HART should identify each spare frog by type; so we can all understand our options, in anticipation of a 3-5 year premature end of life of in service FBFs.

We are simply at a loss on how this whole situation has evolved. Reverse engineering and specification development to meet the product that was installed. HART is doing something none of us have ever seen done before and in conflict with the HRTP 2016 Design Criteria Manual. Now we are concerned that we will inherit their problem that will cost the taxpayers tremendously for years.

As stated previously and we each witnessed HRH MOW Manager, Leroy Henry fully support when HRH O&M Director, Chris White stated: "we can replace the frogs in a year or two" in front of HDOT while we were in the PRSR meeting at the OSB on the 3rd floor in early April ("that is the smartest thing he has heard since he has been on the Island" per HRH MOW Manager, Leroy Henry").

RECOMMENDATION: The bigger risk resides with the turnout FBFs, due to the higher speeds, we must replace these turnout frogs first, within a year or two of passenger service. Three years most likely would not yield the results we desire to achieve. By replacing these frogs it would enable us to make ride quality related adjustments and provide us with a typical maintenance tolerance on the mainline tracks.

Sixty-seven percent of derailments occur at switches and we are heading down a path that no one has ever done before (see figure 2-7 below from the FTA's latest report). DTS will be the first system owner to operate at 55MPH over FBFs and the first system to possess an entire mainline network of FBFs. Even the MBTA doesn't have an entire network of FBFs on their mainline tracks (MBTA has a few FBFs on their mainline). TTCI says there is not safety issue and that is fine for now based off of their study, but Ben Holland, Rolling Stock Compliance Officer (RSCO) believes that TTCI used design simulations versus as-built simulations and that is why TTCI never identified the wheel tread top of frog interference strikes near the frog point, where each frog is only supposed to only be flange-bearing. This same concern was voiced to me by our TCO weeks prior.

MxV Rail (TTCI) responses: (1) The chief advantage of flange bearing over tread bearing is reduced impact and improved ride quality. (2) In Phase II, TTCI ran simulations of worn frogs and wheels that show cases where the wheel has tread bearing across the frog. DTS was aware of the modeling plan before TTCI commenced work. These cases are allowed under HART maintenance limits. These cases also meet CFR 213.333 criteria. Again, the FBF design is intended to be both flange bearing and tread

bearing, depending on wheel flange height. These are not interference strikes, merely tread bearing operations.

TTCI failed to identify the tight gage issue at the DXO's while they were onsite collecting data from our system. This oversight raises concerns that the simulations used for the TTCI Phase 1 report, and the data gathered from the onsite testing are flawed and the report is invalid. Now, after the modifications it appears that TTCI, overlooked the wheel tread contact interference on the top of the frog when it is supposed to be flange bearing, especially at this early stage (How/Why?).

MxV Rail (TTCI) responses: As responded above, Phase I work by TTCI was to use the design track geometry without actual (measured) track geometry and Phase II work was to use the actual track geometry. A request from TTCI to get the actual track geometry for Phase II work identified the tight/narrow gage issue, which TTCI considered in the phase II simulations.

FACT: It's safe, until it isn't. TTCI's own standard states that the dynamic wheel load should be as close to 1.5 times the static wheel loading in operating over the bump. An email from L+E on 3/31/22 states: "...both the static and the dynamic load is shown in the charts in the Phase 1 TTCI report in Section 4.6, figure 71, 72 and 73. The dynamic wheel load is shown in each chart, and the static load is shown with the dashed horizontal line. For the straight through direction, he dynamic wheel load varies between 1.5 and 2.5 times the static wheel load depending on the ramp direction at 55 mph. For the diverging move across the DXO, the dynamic wheel load is about 1.5 - 1.6 times the static wheel load at 20 mph. Note that we already have the AAR wheel load as the evaluation criteria, and that there is no intent to add anything to that criteria."

MxV Rail (TTCI) responses: TTCI does not have dynamic load standards. TTCI's parent company, the Association of American Railroads, has dynamic performance standards for car designs (MSRP, Chapter 11). Vehicles must meet these standards to be certified for operations on AAR member railroads.

The figure cited comes from an AAR sponsored project to improve the performance of crossing diamonds. The AAR cited this figure as a performance goal for new designs. It is based on the recognition that the limited suspension capacity of loaded freight cars can be exceeded when operating over tread bearing crossing diamonds of the time (circa 1995). AAR selected flange bearing frog technology to develop for both crossing diamonds and turnouts. This has been discussed numerous times at HART progress meetings with DTS representatives present. It is not a safety limit; nor is it applicable to transit vehicles with more capable suspensions.

DISCUSSION: We have been told it is safe, but it is a maintenance issue, so when maintenance fails does it become a safety issue? MBTA has had nothing but problems with FBFs and even the FRA updated 213.237 states that is a FBF becomes thread-bearing to reduce speed to class 1 speeds (15 MPH for passenger vehicles). HART's consultant is cherry picking the FRA regulations that support his position on these FBFs. Furthermore, the failure for HART and TTCI to not use TCRP 155 was their decision and DTS did not agree with it.

Since arriving in Honolulu we've been told how MBTA has FBFs and how they operate at higher speeds over these FBFs by HART's consultant. DTS has inquired with consultants working with the MBTA, and we've learned that the MBTA has some (a few) FBFs on their mainline, but most FBFs are in the yard. Furthermore, in spring of 2021 we learned of the MBTA speed restrictions, we informed HART and their

consultant. HARTs consultant stated that the speed restriction was implemented on all frogs, which we learned on April 2, 2021 was incorrect, the speed restriction was imposed on all FBFs, whether they be in the yard or on the mainline tracks.

NOTE: DTS met with HART on May 6, 2022 and HART's consultant did not answer the MBTA current speed restriction question emailed to him a few days prior.

The TTCI Phase 2 Study, points back to the Phase 1 Study often, the problem with this is that the PV and field data gathered for the TTCI Phase 1 Study is flawed, as TTCI nor HART identified the tight gage issue at the diamonds when they performed the onsite data gathering, thus the data they retrieved from the HRTP is flawed, just like the drawings of heavy duty frogs.

MxV Rail (TTCI) responses: (1) The Phase 1 and 2 reports document the analysis done to determine if FBFs are safe to operate with HART vehicles at the intended speeds. All frogs, no matter what the design, will require maintenance. (2) CFR 213.237 describes rail inspection and says nothing at all about frogs. As DTS has stated in this memo, HART is not governed by FRA regulations. The FBFs on HART are designed to be flange and tread bearing. This is important because the frogs have the structural capacity to withstand the higher impacts that will occur with tread bearing operations. The frog design is such that two wear lives can be expected: one flange bearing and one tread bearing. It is also likely that the frogs will spend most of their service lives with some wheels being flange bearing (e.g. the ones with taller flanges) and some wheels being tread bearing (e.g. the newer, shorter flange wheels).

(3) The objectives of on-site inspections and testing for Phase 1 were well documented in Phase I report and were to support modeling simulation for the design track and vehicle conditions. Variations in track gage was not included in the Phase 1 simulations. As said earlier, design track geometry was used in the Phase 1 study, when measured track geometry was not available. All parties, including DTS, concurred with the plan prior to TTCI conducting the phase I work. However, Phase 2 work modelled vehicle and track variations, including actual geometry and track geometry variations such as tight gage.

FACT: The abnormal milling type marks around the frogs that DTS identified back in 2021 are coming back as seen in the EKP and PLR photos that HRH sent to DTS on May 2, 2022. Our TCO and I have never seen these types of marks elsewhere and strongly suggest HART or HRH bring in a true wheel/rail interface expert ASAP.

## MxV Rail (TTCI) responses: MxV Rail inspected the mill scale in the frog at the E. Kapolei and it is the same marks described in TTCI's Phase I report.

HRH's welding program is just beginning and due to their high turnover rate, I have zero confidence that they will be able to maintain the FBF flange way floors, thus we will see many speed restrictions and our customers will suffer undesired delays. Additionally, HRH welders are not AWS qualified. I did qualify a few of my folks over a decade ago and it is expensive and time consuming. If we only had a few FBFs on the mainline, then perhaps HRH might be able to maintain them in a state of good repair. Our customers deserve a safe, reliable and resilient system and the only way for DTS to fulfill our commitment to our passengers is to replace the turnout FBFs within the next two years.

FACT: Our customers will suffer tremendous service delays if we do not have HART replace the turnout FBFs to tread bearing frogs (TBF) within the next year or two.

#### MxV Rail (TTCI) responses: No data, such as wear rates, is presented to support this opinion/prediction.

Issue:

The TTCI Phase 2 report and current track conditions are not in alignment, there are many concerns that do not support our desired customer experience that DTS strives to deliver. DTS can only achieve its customer experience satisfaction goals by using proven TBFs. In addition, please note the following concerns:

1. HART has not been able to identify another system whom uses FBFs operating at higher speeds (55 MPH);

2. HART did certify the resilient wheel, but it is unknown if the wheel study considered tread to flange transitions.

3. A lack of proper commissioning will only lead to new issues to be identified at a later date and we are not staffed to inherit those problems. Who will the taxpayers hold accountable?

4. What simulations tested for an obstruction in the flange way? FRA left in the flange-way depth requirement in their updated 213.137 for those FBFs that become TBF. Why are we not following their lead? TTCI and HART decided to use FRA and ignore TCRP 155, since that was their decision then they should not cherry pick which FRA safety standards we follow.

5. What other systems have modified both the wheels and the frogs months prior to opening?

6. DTS will be taking on too much risk by being the first agency to operate over an entire network of mainline FBFs at a speed greater than the manufacturers recommended MAS of 15 MPH.

7. DTS will inherit the risk for modifying Nortrak's design and operating over their FBFs at a speed that exceeds their recommended speeds.

8. HRH welders are not AWS D15.2/D15.2M Qualified.

9. HRH track inspectors will be inspecting the FBFs at night with unproven jigs.

10. HART's consultant stated that he could not find the data from the TCRP 155 Sect. 6.6.3.2 Flange-way ramping, but then later we were told to talk to a track SME in Pittsburgh whom supported the TCRP 155 study and whom also designed the HRTP to have all FBFs.

#### MxV Rail (TTCI) responses:

- Several of the issues raised are not related to frog design or relevant to safety. These include 3, 5, 7, 8, 9 and 10.
- Item 1 (FBF operating speeds) is likely the case but does not mean the frogs are unsafe. Freight railroads in the United States are operating crossing diamonds at track speeds (40 60 mph)
- Item 2, TTCI's simulations considered the resilient wheel. Our experience with flange bearing on freight systems suggests the tread to flange transition is not likely a significant issue for wheel stresses nor wheel slip control systems. It is less severe than a common engine burn, for example.

- Item 4 (flangeway obstructions) is an issue for all frog designs. Since HART operates on a dedicated, ballast-less mainline right of way, the risk is minimized.
- Item 6 (manufacturers recommended operating speeds of 15 mph for FBFs) is not correct. The HART FBFs were designed and manufactured for HART operation speeds.

#### Considerations:

DTS should inform HART immediately that we will not accept these FBFs and ask them to develop a plan to replace every mainline turnout FBF to a TBF within the next two years. The removed mainline turnout FBFs can be added to the track spares inventory for future use in the yard when those FBFs fail. In addition, the diamond frogs should be continued to be monitored and may require replacement within the first three-to-five years. If replacement happens sooner that the design life, HART and DTS should split the cost based off of the useful life achieved.

#### **Recommendations:**

We strongly recommend that we move forward with the development of a plan to have HART replace the mainline turnout frogs, the diamond FBFs can stay for now and we will continue to monitor them. The consequences in not moving forward with the replacement of the turnout FBFs are too great for DTS to incur especially with the system opening months away. Based on our collective experience, desired customer experience and resilient operations service delivery goals it is not in the best interest for DTS to not request that HART replace these Turnout FBFs with TBFs. Thank you for considering this request for approval.

Next Steps: Notify HART, that DTS will not accept the turnout FBFs and request that HART or HRH bring in a true WRI SME ASAP. The next steps could be as follows:

MxV Rail (TTCI) responses: DTS is advocating the replacement of frogs that are within HRH maintenance limits and that have met all dynamic safety requirements in the simulations performed. They have presented no evidence of safety issues related to the frog design.

- 1. Kickoff meeting with HART;
- 2. Prioritize which turnout frogs get replaced first (EKP, PRL, and LCC should be the first in this order);
- 3. Identify replacement TBFs;
- 4. Order replacement TBFs;
- 5. HART develops contract and schedule for weekend replacements of each turnout frog; and
- 6. DTS & HRH develops bus bridge plan and service disruption announcements (60 days).

Attachments:

- A. DTS Comments on TTCI Phase 1 report
- B. DTS comments on TTCI Phase 2 report

Prepared by: Steven Bose, Senior Operations & Maintenance Manager

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## **RECOMMENDATION: HART should identify each spare frog by type; so we can all understand our options, in anticipation of a 3-5 year premature end of life of in service FBFs.**

We are simply at a loss on how this whole situation has evolved. Reverse engineering and specification development to meet the product that was installed. HART is doing something none of us have ever seen done before and in conflict with the HRTP 2016 Design Criteria Manual. Now we are concerned that we will inherit their problem that will cost the taxpayers tremendously for years.

As stated previously and we each witnessed HRH MOW Manager, Leroy Henry fully support when HRH O&M Director, Chris White stated: "we can replace the frogs in a year or two" in front of HDOT while we were in the PRSR meeting at the OSB on the 3<sup>rd</sup> floor in early April ("*that is the smartest thing he has heard since he has been on the Island*" *per HRH MOW Manager, Leroy Henry*").

RECOMMENDATION: The bigger risk resides with the turnout FBFs, due to the higher speeds, we must replace these turnout frogs first, within a year or two of passenger service. Three years most likely would not yield the results we desire to achieve. By replacing these frogs it would enable us to make ride quality related adjustments and provide us with a typical maintenance tolerance on the mainline tracks.

Sixty-seven percent of derailments occur at switches and we are heading down a path that no one has ever done before (see figure 2-7 below from the FTA's latest report). DTS will be the first system owner to operate at 55MPH over FBFs and the first system to possess an entire mainline network of FBFs. **Even the MBTA doesn't have an entire network of FBFs on their mainline tracks (MBTA has a few FBFs on their mainline).** TTCI says there is not safety issue and that is fine for now based off of their study, but Ben Holland, Rolling Stock Compliance Officer (RSCO) believes that TTCI used design simulations versus as-built simulations and that is why TTCI never identified the wheel tread top of frog interference strikes near the frog point, where each frog is only supposed to only be flange-bearing. This same concern was voiced to me by our TCO weeks prior.



Figure 2-7 Track-caused derailments by sub-group (NTD)

TTCI failed to identify the tight gage issue at the DXO's while they were onsite collecting data from our system. This oversight raises concerns that the simulations used for the TTCI Phase 1 report, and the data gathered from the onsite testing are flawed and the report is invalid. Now, after the modifications it appears that TTCI, overlooked the wheel tread contact interference on the top of the frog when it is supposed to be flange bearing, especially at this early stage (How/Why?).

FACT: It's safe, until it isn't. TTCI's own standard states that the dynamic wheel load should be as close to 1.5 times the static wheel loading in operating over the bump. An email from L+E on 3/31/22states: "...both the static and the dynamic load is shown in the charts in the Phase 1 TTCI report in Section 4.6, figure 71, 72 and 73. The dynamic wheel load is shown in each chart, and the static load is shown with the dashed horizontal line. For the straight through direction, he dynamic wheel load varies between 1.5 and 2.5 times the static wheel load depending on the ramp direction at 55 mph. For the diverging move across the DXO, the dynamic wheel load is about 1.5 - 1.6 times the static wheel load at 20 mph. Note that we already have the AAR wheel load as the evaluation criteria, and that there is no intent to add anything to that criteria." DISCUSSION: We have been told it is safe, but it is a maintenance issue, so when maintenance fails does it become a safety issue? MBTA has had nothing but problems with FBFs and even the FRA updated 213.237 states that is a FBF becomes thread-bearing to reduce speed to class 1 speeds (15 MPH for passenger vehicles). HART's consultant is cherry picking the FRA regulations that support his position on these FBFs. Furthermore, the failure for HART and TTCI to not use TCRP 155 was their decision and DTS did not agree with it.

Since arriving in Honolulu we've been told how MBTA has FBFs and how they operate at higher speeds over these FBFs by HART's consultant. DTS has inquired with consultants working with the MBTA, and we've learned that the MBTA has some (a few) FBFs on their mainline, but most FBFs are in the yard. Furthermore, in spring of 2021 we learned of the MBTA speed restrictions, we informed HART and their consultant. HARTs consultant stated that the speed restriction was implemented on all frogs, which we learned on April 2, 2021 was incorrect, the speed restriction was imposed on all FBFs, whether they be in the yard or on the mainline tracks.

## NOTE: DTS met with HART on May 6, 2022 and HART's consultant did not answer the MBTA current speed restriction question emailed to him a few days prior.

The TTCI Phase 2 Study, points back to the Phase 1 Study often, the problem with this is that the PV and field data gathered for the TTCI Phase 1 Study is flawed, as TTCI nor HART identified the tight gage issue at the diamonds when they performed the onsite data gathering, thus the data they retrieved from the HRTP is flawed, just like the drawings of heavy duty frogs.

FACT: The abnormal milling type marks around the frogs that DTS identified back in 2021 are coming back as seen in the EKP and PLR photos that HRH sent to DTS on May 2, 2022. Our TCO and I have never seen these types of marks elsewhere and strongly suggest HART or HRH bring in a true wheel/rail interface expert ASAP.

HRH's welding program is just beginning and due to their high turnover rate, I have zero confidence that they will be able to maintain the FBF flange way floors, thus we will see many speed restrictions and our customers will suffer undesired delays. Additionally, HRH welders are not AWS qualified. I did qualify a few of my folks over a decade ago and it is expensive and time consuming. If we only had a few FBFs on the mainline, then perhaps HRH might be able to maintain them in a state of good repair. Our customers deserve a safe, reliable and resilient system and the only way for DTS to fulfill our commitment to our passengers is to replace the turnout FBFs within the next two years.

## FACT: Our customers will suffer tremendous service delays if we do not have HART replace the turnout FBFs to tread bearing frogs (TBF) within the next year or two.

#### Issue:

The TTCI Phase 2 report and current track conditions are not in alignment, there are many concerns that do not support our desired customer experience that DTS strives to deliver. DTS can only achieve its customer experience satisfaction goals by using proven TBFs. In addition, please note the following concerns:

- HART has not been able to identify another system whom uses FBFs operating at higher speeds (55 MPH);
- 2. HART did certify the resilient wheel, but it is unknown if the wheel study considered tread to flange transitions.
- 3. A lack of proper commissioning will only lead to new issues to be identified at a later date and we are not staffed to inherit those problems. Who will the taxpayers hold accountable?
- 4. What simulations tested for an obstruction in the flange way? FRA left in the flange-way depth requirement in their updated 213.137 for those FBFs that become TBF. Why are we not following their lead? TTCI and HART decided to use FRA and ignore TCRP 155, since that was their decision then they should not cherry pick which FRA safety standards we follow.
- 5. What other systems have modified both the wheels and the frogs months prior to opening?
- 6. DTS will be taking on too much risk by being the first agency to operate over an entire network of mainline FBFs at a speed greater than the manufacturers recommended MAS of 15 MPH.
- 7. DTS will inherit the risk for modifying Nortrak's design and operating over their FBFs at a speed that exceeds their recommended speeds.
- 8. HRH welders are not AWS D15.2/D15.2M Qualified.
- 9. HRH track inspectors will be inspecting the FBFs at night with unproven jigs.
- 10. HART's consultant stated that he could not find the data from the TCRP 155 Sect. 6.6.3.2 Flangeway ramping, but then later we were told to talk to a track SME in Pittsburgh whom supported the TCRP 155 study and whom also designed the HRTP to have all FBFs.

#### **Considerations:**

DTS should inform HART immediately that we will not accept these FBFs and ask them to develop a plan to replace every mainline turnout FBF to a TBF within the next two years. The removed mainline turnout FBFs can be added to the track spares inventory for future use in the yard when those FBFs fail. In addition, the diamond frogs should be continued to be monitored and may require replacement within the first three-to-five years. If replacement happens sooner that the design life, HART and DTS should split the cost based off of the useful life achieved.

#### **Recommendations:**

We strongly recommend that we move forward with the development of a plan to have HART replace the mainline turnout frogs, the diamond FBFs can stay for now and we will continue to monitor them. The consequences in not moving forward with the replacement of the turnout FBFs are too great for DTS to incur especially with the system opening months away. Based on our collective experience, desired customer experience and resilient operations service delivery goals it is not in the best interest for DTS to not request that HART replace these Turnout FBFs with TBFs. Thank you for considering this request for approval.

#### **Next Steps:**

Notify HART, that DTS will not accept the turnout FBFs and request that HART or HRH bring in a true WRI SME ASAP. The next steps could be as follows:

- 1. Kickoff meeting with HART;
- 2. Prioritize which turnout frogs get replaced first (EKP, PRL, and LCC should be the first in this order);
- 3. Identify replacement TBFs;
- 4. Order replacement TBFs;
- 5. HART develops contract and schedule for weekend replacements of each turnout frog; and
- 6. DTS & HRH develops bus bridge plan and service disruption announcements (60 days).

#### Attachments:

- A. DTS Comments on TTCI Phase 1 report
- B. DTS comments on TTCI Phase 2 report

Prepared by: Steven Bose, Senior Operations & Maintenance Manager

## **Record Drawing Problem Statement**

## Current State:

DTS has recently become aware that HART waived the requirement for the Engineer of Record (EOR) to sign and stamp the final Record Drawings on the West Project Segment. The HART GENERAL CONDITIONS for DESIGN-BUILD CONTRACTS (8/2015) Chapter 2, requires signed and sealed record drawings.

Please note the following definitions from the aforementioned HART plan.

"As-Built Drawings" means the red-lined Construction Drawings produced and maintained by the Contractor to document the details and dimensions of the completed Work.

"As-Built Specifications" means the red-lined Construction Specifications produced and maintained by the Contractor to document the products, methods, and materials incorporated into the completed Work.

"Record Drawings" means the conformed Construction Drawings which comply with HART's Plan Standards and incorporate all changes noted on the As-Built Drawings to document the final constructed Work for turnover to HART. <u>Record Drawings shall be signed and sealed by</u> <u>the Engineer of Record.</u>

We are not aware of a revision to this plan, only two change orders (CO 00062 & CO 00158) that waive the requirement as seen above and within the aforementioned Chapter 2 plan. We are not aware if HART had shared this previously approved plan with the FTA and HDOT.

**Questions:** If HART did share this plan with the FTA and HDOT, was proper notification provided to both stakeholders regarding the change orders? Why wasn't the HART GENERAL CONDITIONS for DESIGN-BUILD CONTRACTS (8/2015) Chapter 2 plan rewritten to reflect this change which happened in 2017? <u>The reason these questions are relevant is because we can anticipate the FTA and/or HDOT inquiring about the as-built drawings to us and to the maintainers of the system (when they interview the maintainers, management is usually excluded from those conversations).</u>

### Change Order 00158 States:

### DESCRIPTION OF WORK:

This Contract Change Order (CCO) No. 00158 is a no cost change to revise the Contract Language, as referenced in Issue No. 00446 Record Drawing Contract Language Revision, as follows:

1. General Conditions of Design Build, Chapter 4, Section 4.27, entitled "AS-BUILT DRAWINGS," shall be deleted in its entirety and the following language shall be substituted in lieu thereof:

"The Contractor shall maintain at the job site an electronic set of contract drawings, marking them in red to show all variations between the construction actually provided and that indicated or specified in the contract documents, including buried or concealed herein, or where variations in scope or character of work from that of the original contract are authorized, the drawings shall be marked to define the construction actually provided. The representations of such changes shall conform to standards and details as necessary to clearly portray the as-built construction.

The drawings shall be maintained and updated on a daily basis. Monthly and final payments to the Contractor shall be subject to prior approval of the updated drawings, including approved Change Order changes to design. On completion of the work, the as-built redline drawings shall be electronically submitted to the Officer-in-Charge and shall be subject to the Officer-in-Charge's approval before acceptance."

*Question:* If contractors have been paid, by definition we should have evidence of approved updated drawings. Is this true?

**Question:** Regardless of whether the prior question is true, this statement demands that we should have in our possession the as-built drawings and associated record of approval from the OIC. Is this true?

2. Rapid Transit Division (RTD) PLANS STANDARDS, Plans Preparation Guide (October 2009) Section 3.12, entitled "PREPARATION OF RECORD DRAWINGS," shall be deleted in its entirety and the following language shall be substituted in lieu thereof: "All drawings are to be contained in electronic files prepared in accordance with the RTD CADD Specification. All AutoCAD files of drawings submitted to HART shall be indistinguishable from the hard copy drawing when printed or plotted by HART using HART equipment. The exceptions to this rule are initials are not required to be replicated in the AutoCAD files.

The Record Drawings and corresponding electronic files shall incorporate all Change Orders, the revisions shown on the Contractor's "As Built" drawings, and the items described below:

• All indications of previous revisions such as clouding and revision letters shall be removed from the body of the drawings. The record of revisions on the drawing border shall be left intact. The revision number shall be advanced by one character and noted in the record of revisions along with the date and the title "Record Drawing."

• The Record Drawing will be electronically initialed in the "By" column of the "REVISION BLOCK" by the person who by doing so certifies that the red-line revisions were accurately incorporated (or that there were none to add). Initials in the "By" column are not required in the AutoCAD files. • These initials shall be in accordance with Section 3.9. A seal shall not be utilized.

• When completed, the Record Drawing shall also receive an identifying stamp "RECORD DRAWING." This stamp will be provided by HART as an AutoCAD file/block. The block shall be placed within the body of the drawing as close to the bottom right corner of the drawing as possible.

• Two (2) hard copy Record Drawings shall be submitted on the 11" x 17" media as specified in the RTD CADD Specification."

3. RTD PLANS STANDARDS, PART 2 CADD Specification of Rapid Transit Division (RTD) PLANS STANDARDS, Plans Preparation Guide (October 2009) Section 8.2, entitled "CADD SHEET FILES," shall be deleted in its entirety and the following language shall be substituted in lieu thereof:

*"For the final submittal, all drawings shall be furnished in native (AutoCAD) file format to HART. Drawing files shall be "purged" of all unused blocks, layers, styles, etc. before submission.* 

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For final submittals, all graphic information associated with an individual drawing shall be wholly contained in a single electronic file. All drawings shall be created according to Section 1.

For final submittals, AutoCAD Xrefs, if utilized, shall be not "bound" to the file. Xrefs shall be provided as separate files.

All CADD Sheet Files shall be delivered in the naming convention discussed in Section 5.3. E.g., WOFH-G07-5D816A-AB.PDF and WOFH-G07-SD816A-RD. PDF."

The changes described herein do not require any additional time for performance. This CCO No. 00158 constitutes an accord and satisfaction and full and final settlement, release and discharge of all claims for all costs and time of performance related to the changes described or referenced herein.

*Except as provided herein, all terms and conditions of the Contract, as modified by prior Contract Change Orders, remain unchanged.* 

In learning of this change in this way, it also raises many concerns. First, since we have been requesting the as-built/record drawings for over a year, with little success; have there been other cuts related to the as-built and/or record drawings? If so, what are they? Second, are all of the final record drawings in CADD? If not, what percentage is in CADD and which percentage is in PDF? Lastly, how accurate are the record drawings? Are all of the record drawings available or was there a decision to waive some of the record drawings?

The absence of properly certified documents identifying the as-built condition of numerous assets/structures/facilities for the HRTP affects us managers in Operations & Maintenance (O&M), and our personnel put in place as well as contracted employees to operate and maintain the system. In addition, to maintenance personnel and crews whose lives depend on the accuracy of these records in the performance of their jobs, without proper plans, O&M also assumes a significant amount of increased liability, not only through accidents and incidents, but through maintenance and sustainment costs as well.

Some specific examples that we have already encountered prior to handover to O&M have been all of the track gage and wheel width uncertainties. How can engineers properly assess condition and therefore make appropriate maintenance decisions, or recommend sound capital improvements to system managers when the source documents are not reliable? And now we are dealing with the hammerhead crack issues. If the consultants use design drawings, how can we have confidence in the assessments and recommendations?

During the Trial Running Phase, O&M should receive a systems configuration documentation (Configuration Items List). How accurate is the configuration list if there are no certified As-Built or Record Drawings to back it up?

We must protect the traveling public and all HRTP employees and thus require accurate as-built and/or record drawings. If we receive inaccurate or incomplete as-built or record drawings that have not been certified by the EOR or OIC, then where does the liability shift? Maintainers of high-voltage systems lives depend on accurate as-built or record drawings. O&M can expect to incur additional expenses because of the lack of certified as-built and/or record drawings for future work.

O&M must protect itself from future potential gross negligence claims and the current unknown state of the as-built and/or record drawings. It is simply too much of a concern to inherit in the current state. There is no question that O&M will inherit a lot of unknowns. How can we accurately assess and assign a risk rating to the unknown risks? What will be the priority when discovered? What will be the cost? What will be the impact to customer service?

### **Desired State:**

FTA provides the following guidance for FTA funded projects:

The project manager should assure the construction contract calls for the contractor to mark up the changes on the drawings and specifications as they occur during construction and turn in a set of marked up drawings and specifications. Under general direction of the project manager the construction manager verifies the construction contractor is keeping the drawings up to date. The project manager should provide in the agreement with the designer of record scope for the designer to review, approve, and produce the final as-built drawings.

The commissioning manager will use the as-built documentation as necessary to commission the project. As-built drawings will save significant life cycle costs and avoid potential safety hazards during operations and life of the facilities. The commissioning manager will review the final as-built drawings and assure they are a part of the final commissioning report.

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